Civil Engineering

What is Civil Engineering?

What can you do as a Civil Engineer?

Curriculum at CU

- *"Engineers solve ill-defined problems that have no single "right" answer but many better or worse solutions…."*

  – *Engineering and the Mind's Eye, Ferguson*

ABET Definition:

- Engineering is the **profession** in which knowledge of **math** and **sciences**,
- gained by **study**, experience, and **practice**,
- is applied with judgement to develop ways to **economically** utilize the materials and forces of nature to **benefit** mankind

Profession = knowledge, organization, public good

- *"ultimately, what most satisfies engineers is complex, technical problem-solving and the opportunity to work with stimulating colleagues and to make a meaningful contribution to society"*

  –The Civilized Engineer, S.C. Florman

Engineering is:

- Applied science
- Problem solving
- Science and "art"

What is Civil Engineering?

- The oldest engineering profession
- Projects that benefit society as a whole
- Sub-disciplines
  - –Transportation
  - –Structures
  - –Environmental & Water Resources
  - –Geotechnical
  - –Construction

Transportation

- Design roadways
  - –Where to locate
  - –Number of lanes, width of lanes, slope of lanes, HOV lanes
  - –Traffic control: stop light timing, pvmt markings (lines, raised reflectors), signs
  - –Bridges
  - –Pavement type - asphalt vs concrete
  - –Drainage
  - –Safety: shoulders, guard-rail, etc.

Intersection Design

- Stop lights vs stop signs
  - Set timing vs trigger
  - Time of day variances
    - (night to flashing yellow, flashing red)
- Turn lanes vs. no turn lanes
- T-intersection versus Y
- Pedestrian and bicycle access

Transportation

- Design airports
  - –Runways: orientation per wind direction, length per plane types
  - –Taxi-ways
  - –Terminals and parking
  - –Noise, de-icing, environmental concerns
- Design light rail, railroads
  - –Route selection
  - –Grading
  - –Tunnels
  - –Terminals

Structural

- Design Bridges
- Design Dams
  - –Three Gorges Dam in China
- Design Skyscrapers
  - –Taller,
  - –Resistant to earthquake damage

Structural

- Select materials
  - –Steel, reinforced concrete, wood
- “Dead load” forces
  - –Weight of structural members and walls, floors, furnace, etc.
- Dynamic forces
  - –Wind, water, earthquakes, moving vehicles

Environmental & Water Resources

- Treat water so it is clean to drink
- Treat wastewater so it is safe to return to rivers, lakes, and into the ground
- Clean-up hazardous wastes
  - – Rocky Flats, “A Civil Action”, “Erin Brockovich”
- Supply enough water for public use
- Design solid waste handling

Environmental & Water Resources

- How clean is clean?
- What is safe?
  - –Pathogens and disease-causing bacteria...
  - –Chemicals that cause cancer, birth defects...
  - –Human safety vs fish, frogs, birds, etc.
- Fundamentals: chemistry, biology, microbiology

Geotechnical

- Design foundations
  - –Expansive soils in Colorado
  - –Buildings and roads
- Tunnels
- Stable slopes on road cuts, etc.
- Landfills

Construction

- Getting a design from plans on paper to implementation in the real world
  - –Over-sight for construction activities
  - –Certifying built to specifications
- Scheduling construction stages
  - –When to get supplies on site
  - –Critical path: tasks that can only be done once other tasks have been completed
- Estimating costs

- Most major engineering projects today are multi-disciplinary so you will work with other engineers and non-engineers
  - – Wastewater plant = environmental, structural, electrical, mechanical, ….
  - – New road = transportation, geotech, structural (if a bridge), environmental (impact stmt),….
  - – Government regulations, public input

What new engineers need to know? (industry surveys)

Skills	Ranks	% important
Communication	1 / 1	89
Teamwork	3 / 4	94
Ethics	2	85
Creative thinking	3	85
Design	7 / 2	88
Fundamentals	5	73

Also: business skills (3), computing (5)

What can you DO as a civil engineer?

- **Design** a road, bridge, water treatment plant, etc.
- **Talk** with the public, clients, etc. to determine their needs
- **Field work** - oversee construction, test materials on site, collect samples, ….
- Work with a **TEAM** to complete complex tasks

…what else can you DO?

- **Write** technical reports, expert opinions, etc.
- Work with computer-aided design programs
- **Travel** to job sites
- Have **meet**ings with clients, etc.
- Give oral **presentations** to public, answer questions, ….
- Do **research** in a laboratory

A wide variety of opportunities in Civil Engineering is the KEY.

Find what fits your personality the best!

Many Civil Engineers will do all of the previously listed tasks over a career….

Civil Engineering Work

- Federal, state, local government 32%
  - –Environmental Protection Agency
  - –Department of Transportation
  - –City Engineer
- Consulting firms and industry 49%
  - –From international to single office
- Private business / self employed 14%
  - –Highest % of all engineering types!
- Peace Corps/social service abroad

There is always a need for Civil Engineers

- We always need to modify roads
- We always need clean water to drink
- We always have wastes to treat and dispose
- We always build new structures on soil
- …we always want cheaper and better ways to improve all of the above….

….job security!

Civil Engineers are needed to solve Problems in Colorado

- "Crisis looms as aquifers drawn down"
  - –June 24, 2001; Denver Post, front page
  - –Groundwater use exceeding resupply, so water levels in local wells dropping
  - –Water resources engineers needed

Civil Engineers are needed to solve Problems in Colorado

- "State's aging bridges draw scrutiny"
  - –Feb. 20, 2001; Denver Post, front page
  - –Aging bridges need repairs before disaster
  - – Nationwide ~29% of 587,755 bridges "deficient"
  - –Structural engineers needed

Civil Engineers are needed to solve Problems in Colorado

- "Yale, Hampden sections to see first T-REX work"
  - Wednesday, June 13, 2001; Denver Post
  - I-25 expansion to keep pace with traffic growth
  - Transportation and construction engineers needed
    - Good design important for traffic flow when done
    - Good planning for construction needed to minimize public inconvenience during construction
  - Large amount of public concern

Civil Engineers are needed to solve Problems in Colorado

- "EPA: Gold mine fouling water"
  - April 13, 2001; Denver Post, pg. B1
  - Cyanide, copper exceed limits in nearby surface waters, violating Clean Water Act
  - Fish kills, etc. likely
  - Environmental engineers needed

Civil Engineering at CU

- 37 professors & 4 senior instructors
- Most classes 20-60 students
- "General" CE degree
  - structures, geotech, construction, env/water
- Environmental & Water Resources track
  - More depth in env/water, less in others
- Combined BS/MS possible

Std Year 1 Classes

Calculus 1 for Engr	4	Calculus II for Eng	4
Chemistry for Engr	3	Physics I	4
Chem Lab for Engr	2	Plane Surveying	3
Intro to Computing	3	Engrg Geology	3
Intro to CE	1		
SS&H Elective	3	SS&H elective	3
TOTAL:	16 cr.		17 cr.

Notes on Recommended Schedule:

- Course schedule to graduate in 4 yrs
  - 4.5 yrs average
  - Some classes offered in summer
- Time management will be important
  - - # credits vs contact hrs + homeworks
  - Sem 1: 16 vs 19 + (?48?)
- If deviate from the recommended schedule, watch pre-requisites and check with advisor
- Important to get off to a good start!

Advisors

- Goal: to help you select classes
  - Also help if on probation, transfer classes, etc.
- Assigned by department
  - Somewhat random
  - Can change to fit interest area (structures, environ, etc), personality, etc.
- MUST see each semester prior to registration
  - 1 designated week per semester for advising
  - Computer has block until we remove it
  - Will keep you on track, advise of course changes, etc.

Further required classes

- Increase complexity as you build on basic math and sciences
  - Design bridges, buildings, water distribution systems, wastewater plants etc. senior year
  - Pre-reqs become increasingly important
- Technical Electives
  - More depth in specific sub-topics
- Some classes only offered spring or fall...

Civil Engineering classes...

- Lots of hands-on
  - ITLL modules to demonstrate concepts in fluids, hydraulics, thermodynamics...
  - Labs in materials, geotechnical, environmental...
- Tours and real world ties
  - Local job sites, facilities
  - Design projects, faculty research

- Almost all CE classes are taught by professors or full-time instructors
  - May be outside professional for grad class
  - <1 class/semester by PhD student
- Most large classes have a teaching assistant (TA)
  - Graduate students
  - Run lab sections, "recitations"
  - Grade homeworks
  - Have office hours to help with your questions

Where is my professor?

- Come ask questions during office hours
- When not in office:
  - Teaching other classes
  - Working on research (>half our time)
    - In laboratory with graduate students
    - Writing papers, books (may be at home)
  - Service activities (faculty meetings, professional society meetings, expert panels)

To Select SS&H Electives

- Need some level of "depth" in at least 1 topic (require $\geq$3000-level course)
- Can complement engineering courses
  - Economics, business, "engrg and society"
- Can explore range of interests
  - Languages, psychology, sociology, history, ...

Take advantage of opportunities

- Professional societies
  - ASCE = general civil engineering; concrete canoe, steel bridge, prof. contacts
  - AGC = construction; speakers, contacts
  - SEE = environmental; tours, community projects
- Undergraduate research
- Summer internships

To Graduate

- 128 credits minimum
- Fulfill required courses
  - Graduate on "catalog" that you enter with, or any new curriculum up to graduation if ALL requirements are met
- Cumulative GPA >2.00
- Departmental GPA >2.00 (CEAE classes)
- Take the Fundamentals of Engineering (FE) exam

After you graduate:

- Improvements in technology, regulations, etc. change the "state-of-the-art" in civil engineering
  - Life long learning!
- Becoming a registered Professional Engineer (PE) is important